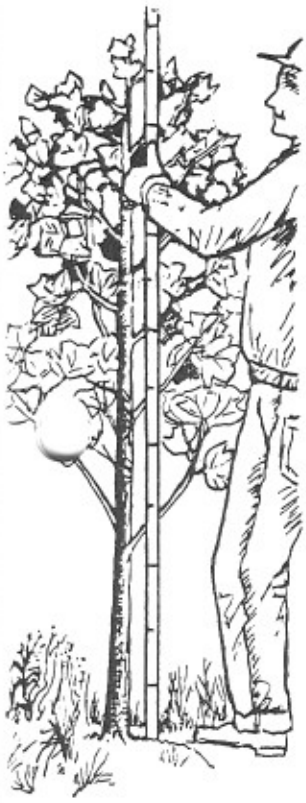

Occasional Report 75 February 1989

LOBLOLLY PINE RELEASE STUDY

REPORT NUMBER

8

Virginia
Department of Forestry

LOBLOLLY PINE RELEASE
Report Number 8

by
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Abstract. This study included two treatments: no release and mist-blowing of 2,4,5-T with a backpack mist-blower during the third growing season. Hardwood competition was severe at the time release was done. At age 21, mist-blown plots averaged 88 percent more basal area and 98 percent more volume in standard cords than check plots, and cordwood yields were related to hardwood basal area (r^2 = .794).

INTRODUCTION

This is the eighth in a series of Occasional Reports concerning release of loblolly pine seedlings from hardwood competition. This particular study was installed on the privately-owned George Biscoe tract in Spotsylvania County, in the northeastern Piedmont of Virginia. Site preparation consisted of a prescribed burn in September of 1965. Loblolly pine seedlings were planted in March of 1966.

The release study was installed on June 24, 1968, during the third growing season. Six swaths, each 80 feet wide and 360 feet long, were laid out, and alternate swaths were released (Figure 1). A backpack mist-blower was used to apply two pounds active ingredient of 2,4,5-T per acre. Mist-blowing was done by walking the boundary line between swaths and spraying toward the middle of the swath to be released. The chemical mixture was blown at least 40 feet into the swath to give complete coverage.

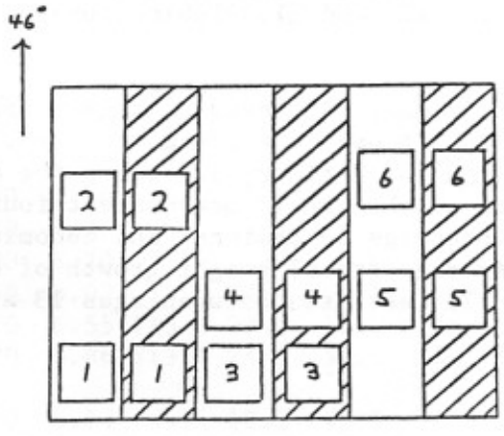


Figure 1. Layout of study and growth plots. Mist-blown swaths are cross-hatched.

Hardwood competition was severe when the release was done. Many hardwoods, particularly chestnut oak stump sprouts, were already too tall and dense for good coverage by the mist-blower. Even so, hardwood control was quite good--better than that usually obtained with a backpack mist-blower. We did the mist-blowing when there was little or no wind, but some damage from drift still occurred in all three check swaths. The year after mist-blowing, this drift damage was so severe that we considered abandoning the study. Several years later, however, the differences between check and released swaths were so striking that we decided to install growth plots.

GROWTH PLOT INSTALLATION

When the plantation was nine years old, six pairs of 1/10-acre growth plots were installed. Check plots were installed in areas where drift damage was minimal (Figure 1). Volunteer Virginia and shortleaf pine seedlings were cut down when the plots were installed.

Measurements were made at age 9, when the plots were installed, and again at ages 13, 17, and 21. Diameter at breast height of each loblolly pine was measured to the nearest inch. For a sample of trees in each diameter class, total height to the nearest foot was also measured, noting which trees were dominant or codominant. Hardwoods were measured at ages 9 and 21. At age 9, all hardwoods greater than .5 inches DBH were tallied by species and 1-inch diameter class. During the final measurement, at age 21, all hardwoods over .5 inches DBH were tallied by species, 1-inch diameter class, and crown class. Total height was also measured to the nearest foot on two-thirds of the dominant and codominant trees.

RESULTS AND DISCUSSION

A summary of loblolly pine data from the four measurements is presented in Table 1. At age 21, mist-blown plots averaged 13.0 standard cords more per acre than check plots.1/ Differences due to release increased with time. Basal area differences were 25.8, 41.7, 50.1, and 57.6 square feet per acre at ages 9, 13, 17, and 21, respectively. Yield differences were 6.2, 9.6, and 13.0 standard cords at ages 13, 17, and 21. Table 2 presents stand tables for loblolly pine at age 21.

The age 13 measurement was made in December of 1978, and the following spring, on Easter Day of 1979, a severe ice storm occurred. This ice storm broke the tops of many trees on these plots, affecting the average height of dominant and codominant trees at the age 17 measurement four years later (see discussion of effect of ice breakage on dominant and codominant height in Release Reports 5 and 6). Average annual height growth of dominant and codominant trees was about .75 feet less between ages 13 and 17 than between ages 17 and 21 (Table 1).

1/ Standard cords at age 21 were subjected to an analysis of variance. Yields on mist-blown plots were significantly greater than yields on check plots (probability of a larger F = .001).

Table 1. A summary of loblolly pine data for check and mist-blown plots at ages 9, 13, 17, and 21 years: number of trees per acre, average DBH, basal area per acre, standard cords per acre, and average height of dominant and codominant trees.

		Check						Mist-blown				
Age	Plot	No.	DBH	B.A.	Cds.	Ht.	Plot	No.	DBH	B.A.	Cds.	Ht.
9	1	370	2.27	15.1	-	24.6	1	280	3.89	24.4	-	24.2
	2	300	2.03	9.2	-	23.0	2	500	4.06	48.9	-	27.5
	3	150	2.30	6.2	-	21.3	3	450	4.47	50.6	-	28.5
	4	510	2.79	26.8	-	26.2	4	540	3.93	49.4	-	28.5
	5	520	3.64	41.5	-	25.3	5	450	4.33	48.1	-	24.9
	6	530	3.21	34.3	-	25.7	6	670	4.13	66.6	-	26.3
	Means	397	2.71	22.2	-	24.4		482	4.14	48.0	-	26.6
13	1	250	3.96	25.2	2.4	34.9	1	280	5.57	49.6	5.6	32.7
	2	180	3.79	16.2	1.1	31.8	2	480	5.27	77.9	9.7	36.6
	3	120	3.75	11.7	1.0	32.0	3	430	5.86	83.1	10.7	37.2
	4	390	4.54	48.5	5.0	35.5	4	520	5.29	84.2	10.6	37.1
	5	490	5.00	71.0	8.2	35.7	5	440	5.82	84.0	10.7	35.3
	6	460	4.93	64.7	7.6	37.2	6	620	5.55	109.2	14.8	38.5
	Means	315	4.33	39.6	4.2	34.5		462	5.56	81.3	10.4	36.2
17	1	210	4.86	31.5	4.1	38.9	1	270	6.41	64.2	9.9	38.7
	2	150	4.93	22.0	2.6	36.6	2	460	6.17	100.7	16.6	41.6
	3	100	5.20	17.9	2.3	37.5	3	370	6.65	92.1	15.9	42.2
	4	350	5.40	59.7	8.4	39.2	4	510	6.08	109.3	18.8	42.9
	5	480	5.83	94.2	16.0	44.2	5	430	6.84	113.2	20.7	43.2
	6	450	5.89	90.3	16.2	45.5	6	600	6.28	136.5	25.5	45.4
	Means	290	5.35	52.6	8.3	40.3		440	6.40	102.7	17.9	42.3
21	1	180	6.00	40.0	7.2	44.6	1	270	7.22	81.9	15.5	45.3
	2	110	6.36	25.4	4.6	44.2	2	440	6.84	118.0	24.0	47.9
	3	100	6.20	25.4	4.6	43.6	3	370	7.22	108.7	22.0	47.6
	4	340	6.03	72.8	13.8	46.1	4	500	6.74	131.2	27.8	50.8
	5	470	6.55	115.6	23.9	50.2	5	420	7.60	137.3	31.5	51.4
	6	420	6.86	113.1	25.1	52.6	6	540	7.20	160.7	36.7	51.4
	Means	270	6.33	65.4	13.2	46.9		423	7.14	123.0	26.2	49.1

Table 2. Average number of loblolly pine per acre by diameter class at age 21.

DBH	Check Plots	Mist-Blown Plots
2	5	2
3	15	5
4	20	18
5	33	38
6	52	78
7	71	102
8	45	107
9	25	42
10	2	28
11		3
12	2	
Totals	270	423

A summary of hardwood data at age 9 is presented in Table 3: numbers of hardwoods greater than .5 inches DBH per acre by species and diameter class, and basal area per acre. At age 9, check plots had more than twice as many hardwoods and almost three times as much hardwood basal area.

A summary of hardwood data at the final measurement at age 21 is presented in Tables 4 and 5. Considering all hardwoods over .5 inches DBH, numbers were 64 percent greater and basal area 148 percent greater on the check plots. Considering only intermediate, codominant, and dominant hardwoods, check plots averaged 255 trees and 24.1 square feet of basal area per acre, while mist-blown plots averaged only 49 trees and 4.8 square feet of basal area per acre. Table 6 presents hardwood data at age 21 by individual plots.

Table 3. Average numbers of hardwoods per acre by species and diameter class, and basal area per acre, at age 9.

Check Plots

Species	DBH 1	2	3	4	5	Totals
Chestnut oak	957	307	75	2	2	1,343
Red oak	358	98	7			463
White oak	335	85	3			445
Dogwood	153		2			155
Black cherry	18	20	7			45
Blackgum	220					220
Hickory	193	7				200
Red maple	15	2				17
Sassafras	33					33
Miscellaneous	23					23
Totals	2,325	519	94	2	2	2,944
Basal Area						29.2

Mist-blown Plots

Species	DBH 1	2	3	4	5	Totals
Chestnut oak	447	93	22	2	2	566
Red oak	273	40	3			316
White oak	122	3				125
Dogwood	43	2				45
Black cherry	27	7				34
Blackgum	23					23
Hickory	45					45
Red maple	43	3				46
Sassafras	3					3
Miscellaneous	10	2				12
Totals	1,036	150	25	2	2	1,215
Basal Area						10.6

Table 4. Average numbers of hardwoods per acre by species and diameter class, at age 21.

Check Plots

Species	DBH 1	2	3	4	5	6	7	8	Totals
Chestnut oak	312	253	174	77	45	11		4	876
Red oak	120	120	43	18	5				306
White oak	167	125	59	13					364
Dogwood	127	33	3						163
Black cherry	10	15	5	7	10				47
Blackgum	351	17							368
Hickory	218	23	8						249
Red maple	13	5	2						20
Sassafras	20	3							23
Yellow-poplar	2	2							4
Miscellaneous	10	2							12
Totals	1,350	598	294	115	60	11		4	2,432

Mist-blown Plots

Species	DBH 1	2	3	4	5	6	Totals
Chestnut oak	299	118	43	23	12	2	497
Red oak	123	117	28	5	3		276
White oak	107	38	7				152
Dogwood	93	22					115
Black cherry	28	13	13				54
Blackgum	105	2					107
Hickory	105	15					120
Red maple	50	22	2	3			77
Sassafras	10						10
Yellow-poplar	2						2
Miscellaneous	65	5					70
Totals	987	352	93	31	15	2	1,480

Table 5. Average numbers of hardwoods per acre by diameter class and crown class, and basal area by crown class, at age 21. *

Check Plots

DBH	Over-topped	Intermediate	Codominant	Dominant	Totals
1	1,350				1,350
2	598				598
3	207	87			294
4	22	58	35		115
5		5	55		60
6			11		11
7					
8			2	2	4
Totals	2,177	150	103	2	2,432
B.A.	32.5	10.0	13.4	.7	56.6

Mist-blown Plots

DBH	Over-topped	Intermediate	Codominant	Dominant	Totals
1	987				987
2	352				352
3	81	12			93
4	11	13	7		31
5		5	10		15
6			2		2
Totals	1,431	30	19		1,480
B.A.	18.0	2.4	2.4		22.8

*Figures may vary from text due to rounding.

Table 6. Numbers of hardwoods by diameter class and crown class, and basal area by crown class, on each 1/10 acre plot.

Plot - Check #1

DBH	O	I	CD	D	Totals
1	83				83
2	55				55
3	24	5			29
4	3	7	4		14
5			8		8
6			3		3
7					
8			1		1
Totals	165	12	16		193
BA	3.09	.86	2.38		6.33

Plot - Check #2

DBH	O	I	CD	D	Totals
1	143				143
2	78				78
3	20	22			42
4	1	11	9		21
5			6		6
6			1		1
7					
8					
Totals	242	33	16		291
BA	3.55	2.04	1.80		7.39

Plot - Check #3

DBH	O	I	CD	D	Totals
1	183				183
2	63				63
3	19	11			30
4		7	7		14
5			7		7
6			2		2
7					
8				1	1
Totals	265	18	16	1	300
BA	3.30	1.15	1.96	.35	6.76

Plot - Check #4

DBH	O	I	CD	D	Totals
1	119				119
2	59				59
3	23	11			34
4	3	6	1		10
5		1	4		5
6					
7					
8					
Totals	204	18	5		227
BA	3.33	1.20	.63		5.16

Plot - Check #5

DBH	O	I	CD	D	Totals
1	126				126
2	40				40
3	21				21
4	2	4			6
5			1		1
6			1		1
Totals	189	4	2		195
BA	2.76	.35	.33		3.45

Plot - Check #6

DBH	O	I	CD	D	Totals
1	156				156
2	64				64
3	17	3			20
4	4				4
5		2	7		9
6					
Totals	241	5	7		253
BA	3.43	.42	.95		4.80

Plot - Mist-blown #1

DBH	O	I	CD	D	Totals
1	130				130
2	54				54
3	14	5			19
4			4		4
5			3		3
Totals	198	5	7		210
BA	2.57	.24	.76		3.58

Plot - Mist-blown #2

DBH	O	I	CD	D	Totals
1	96				96
2	27				27
3	6				6
4	1	2			3
5			1		1
Totals	130	2	1		133
BA	1.49	.18	.14		1.81

Plot - Mist-blown #3

DBH	O	I	CD	D	Totals
1	93				93
2	35				35
3	10				10
4	2	1			3
5					
6					
Totals	140	1			141
BA	1.94	.09			2.02

Plot - Mist-blown #4

DBH	O	I	CD	D	Totals
1	108				108
2	22				22
3	8				8
4	2	4			6
5		3	2		5
6			1		1
Totals	140	7	3		150
BA	1.64	.76	.47		2.86

Plot - Mist-blown #5

DBH	O	I	CD	D	Totals
1	76				76
2	38				38
3	7	2			9
4	2	1			3
Totals	123	3			126
BA	1.76	.18			1.95

Plot - Mist-blown #6

DBH	O	I	CD	D	Totals
1	89				89
2	35				35
3	4				4
4					
Totals	128				128
BA	1.44				1.44

At age 21, there were a total of 63 dominant and codominant hardwoods on the six check plots and 11 on the six mist-blown plots (63 and 11 trees on 6 plots represent 105 and 18 per acre). Of these 74 trees, 58 were chestnut oak, 9 scarlet oak, 3 black oak and 4 black cherry. Table 7 compares the average heights of dominant and codominant loblolly pines and hardwoods at age 21. Some of the hardwoods will continue to grow rapidly enough to maintain a place in the canopy. At age 21, we "estimated" that only check plots 5 and 6 would ultimately have more than 90 percent pine in the canopy, check plot 4 about two-thirds pine, and check plots 1, 2, and 3 probably less than half pine.

Table 7. Average height in feet of dominant and codominant trees at age 21.

Treatment	Loblolly		Hardwood	
	Mean	Range	Mean	Range
Check	46.9	39 to 55	42.0	35 to 48
Mist-blown	49.1	42 to 58	40.7	38 to 44

Cordwood yields of loblolly pine at age 21 were related to the amount of hardwood present. Figure 2 shows pine cordwood yields relative to total hardwood basal area in trees greater than .5 inches DBH. A simple linear regression fitted to the data from the 12 plots accounted for 79 percent of the variation in cordwood yields.2/ A regression of yields over hardwood basal area in intermediate, codominant, and dominant trees also accounted for 79 percent of the variation in yields.

Dominant and codominant loblolly pines have averaged about 2 feet taller on the released plots than on the check plots at all four measurements. Looking at topographic position, soil, and hardwood species composition, there is nothing to suggest that site index is higher on the released plots. Hardwood competition seems to have affected average height of dominant and codominant pines. A plotting of average dominant and codominant height of loblolly pine at age 21 over hardwood basal area--for all twelve plots-- shows a significant relationship between pine height and hardwood competition (Figure 3)./3

2/ Estimated standard cords = 37.63 - .452 (hardwood basal area), r^2 = .794. probability of a larger F = .0001.

3/ Estimated pine height = 50.38 - .167 (hardwood basal area in I, CD, and D trees) r^2 = .513, probability of a larger F = .009. A regression of pine height over total hardwood basal area (trees greater than .5 inches) was also significant: r^2 = .451, probability of a larger F = .017.

Figure 2. Pine cordwood yields at age 21 relative to total hardwood basal area.

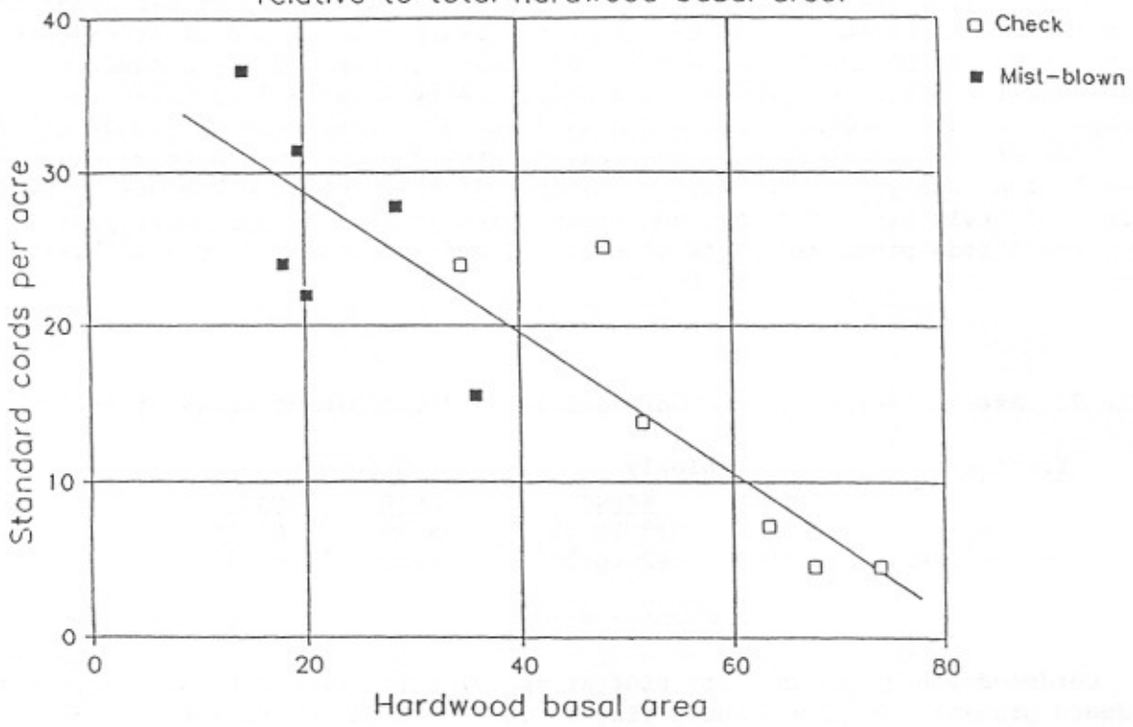
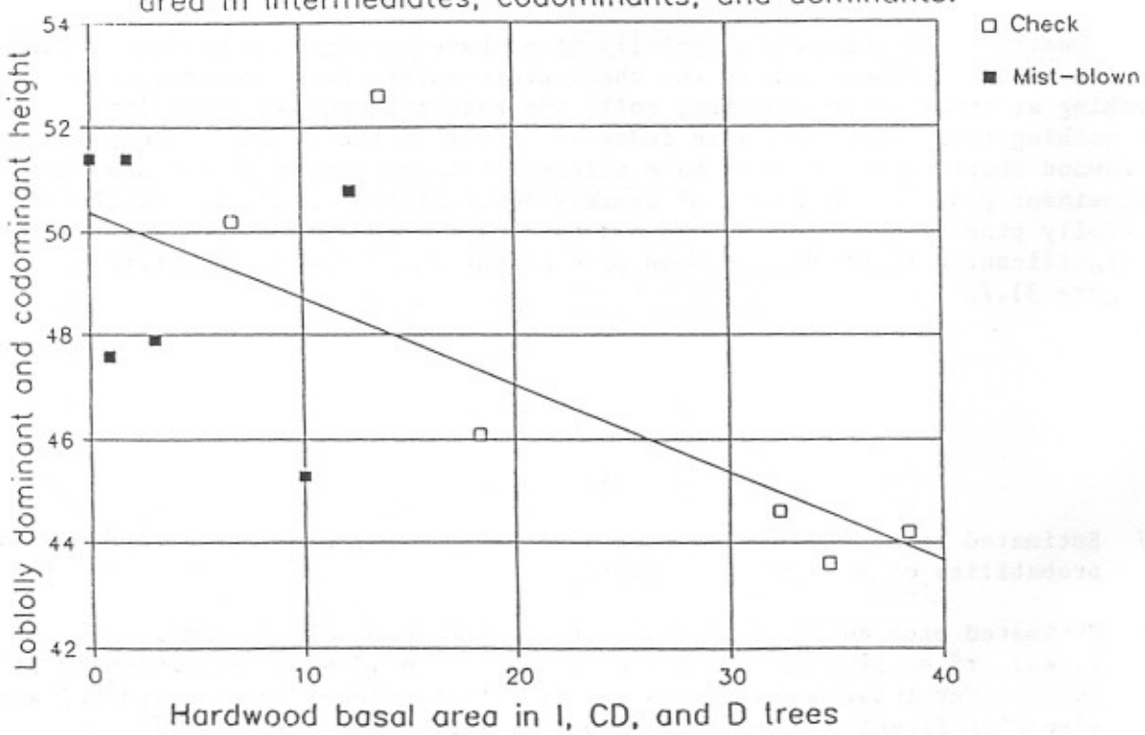


Figure 3. Dominant and codominant loblolly height at age 21 relative to hardwood basal area in intermediates, codominants, and dominants.



We have made final measurements on 21 different release studies, and have looked at the relationship between dominant and codominant loblolly pine height and hardwood basal area. Regressions of loblolly height over hardwood basal area have been significant or nearly significant for 11 of the 21 studies: at the 1 percent level for 4 studies, at the 5 percent level for 5 studies, and just below the 5 percent level for 2 studies. In general, the studies with significant or nearly significant regressions are the ones which had the greatest amount of hardwood competition (basal area).

Loblolly pine seedlings frequently spend a number of years partially suppressed by hardwood competition, later outgrowing this competition and becoming codominant or even dominant trees in the final stand. Theoretically, trees measured to estimate site index should have been dominant or codominant all their lives. In practice, however, there is no way to determine whether a tree that is codominant or dominant at age 21 (as in this particular study) has always been codominant or dominant. The greater the hardwood competition on a plot, the greater the likelihood (almost certainty) that some of the codominant and dominant pines were initially in an intermediate or even over-topped crown position. This seems the most likely explanation of the significant relationship between codominant and dominant pine height and hardwood basal area that we have observed on many of our release studies.4/

4/ Regressions of pine height over hardwood basal area were significant or nearly significant in 4 of 7 previously published release studies:

Release Report No. 3, probability of a larger F = .054
Release Report No. 5, probability of a larger F = .039
Release Report No. 6, probability of a larger F = .007
Release Report No. 7, probability of a larger F = .062